Original communication

Trends in deliberate interpersonal violence in the Odense Municipality, Denmark 1991–2002. ☆
The Odense study on deliberate interpersonal violence

Christian Faergemann [a,*], Jens Martin Lauritsen [a,b], Ole Brink [c], Ole Skov [a]

[a] *Accident Analysis Group, Department of Orthopaedics, Odense University Hospital, DK-5000 Odense C, Denmark*
[b] *Institute of Public Health, University of Southern Denmark, Sdr. Boulevard 23A, DK-5000 Odense C, Denmark*
[c] *Department of Orthopaedics, Aarhus University Hospital, DK-8000 Aarhus C, Denmark*

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Abstract

A 12-year study was carried out to investigate the development of interpersonal violence based on A and E department and/or forensic data from a Danish urban population. Included in the study were all victims of violence from the Odense municipality treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1991–2002. Overall 14,316 victims of violence were included in the study. The incidence rates of violence were 9.9 and 3.4 per 1000 population/year for males and females. For males the incidence rate decreased in the study period whereas the incidence rate was unchanged among females. Less serious lesions and wounds were the most common type of lesions. The percentage of less serious lesions increased in the study period. The percentage of potential severe lesions such as bone fractures and deep lesions decreased in the study period. The percentage of patients stabbed or cut with knifes, the percentage of gunshots, and the mortality rate did not change in the study period. The present study showed no evidence of an increased frequency or severity of interpersonal violence which contrasts with the increased public concern about violence.
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1. Introduction

Deliberate interpersonal violence is one of the leading causes of injury worldwide.[1] Each day the media bring violence to public attention. It appears to have become a common opinion in Denmark that the frequency of violence has increased, and that injuries have become more severe. According to a Danish survey 42% of females and 9% of males avoid empty or desolate parts of cities because of the risk of exposure to violence or sexual assault.[2]

Previous studies based on police crime statistics have shown an increasing frequency of violence.[3,4] However, papers have documented the limitations of these data sources due to high level of non-reporting.[4–7] Therefore, the use of hospital based data in violence research and prevention has been recommended.[6–9]

Numerous papers have described the frequency and severity of violence based on hospital data. The majority of these papers cover a short period of time, whereas studies showing the development in frequency and severity over decades are few. Sivarajasingam et al. found no overall significant change in levels of violence between 1995 and 2000 in an English and Welsh population.[10] A Norwegian study showed a 15–20% decrease in the annual incidence rates of

violence in the period 1990–1997.[11] A Swedish study showed an increase in the age-standardized incidence rate of hospital admissions following violence in males 1987–1994.[12] In a previous Danish study covering the study periods 1981–82, 1987–88, and 1993–94 the annual incidence rates decreased from 6.5 to 4.6 per 1000.[5]

Temporal changes in severity of violence are not well researched. Brink found no change in the severity of lesions, and the frequency of penetrating violence and the use of weapons remained unchanged in a Danish population in the periods 1981–82, 1987–88, and 1993–94.[13] Boström et al. showed an increasing frequency of stab wounds in a Swedish population during the time period 1985–1993.[14] However, more studies on the development in lesions and severity of violence are needed.

The aim of this study was to describe the development in the frequency and severity of physical deliberate interpersonal violence based on hospital and/or forensic data from a Danish urban population during the time period 1991–2002.

2. Methods

Physical deliberate interpersonal violence has previously been defined by the World Health Organisation.[1] The population base for the study was the Odense Municipality in Denmark for the period 1991–2002. All victims of violence treated at the open access accident and emergency (A and E) department at Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark were included as cases. In cases of more than one contact for the same incident, only the first contact was included. Included were only those victims who were residents of the Odense Municipality at the time of the incident of violence. The Odense Municipality is a well-defined urban geographic area with a population of 185,000 inhabitants, mainly consisting of the city of Odense. The municipality has only one A and E department located at the Odense University Hospital, and one Institute of Forensic Medicine located at the University of Southern Denmark.

From the routine patient registration system at the A and E department at Odense University Hospital the cases for this study were included prospectively and consecutively as they presented in the A and E department for treatment. The patient registration system includes self-report information coded with the NOMESCO classification for 37,000 trauma patients annually.[15] All registration is made by the trained staff. The registration of patients with injuries from violence requires that patient disclose this information as being due to an assault. Trained physicians determine the diagnoses according to the ICD system. Before 1994, the ICD8 codes were used with a maximum of three diagnoses for each patient, and from 1994 and onward the ICD10 codes are used with a maximum of five diagnoses for each patient.

The cases from the Institute of Forensic Medicine were identified by complete review of all autopsy reports carried out by the first author. For cases in compliance with the study case definition the NOMESCO classification and ICD10 coding with a maximum of five diagnoses were recorded for each patient. In Denmark, all victims who die from violence undergo a medicolegal autopsy.

For all cases information on age, gender, diagnoses, and days of hospitalisation was obtained from the patient registration system, medical records and/or from autopsy reports.

Based on mid-year population counts we estimated age and gender specific annual incidence rates in five different age groups. The development in violence severity was determined by analysing weapon use for the whole study period and by analysing ICD based diagnoses from 1994 and onwards. The latter was due to inconsistency between ICD8 and ICD10.

Non-parametric statistics with STATA 8™ was used in all statistical analyses and a p-value < 0.05 was considered as statistically significant. All incidence rates were calculated with 95% confidence intervals (95% CI). Poisson regression was used in analyses of changes in annual incidence and mortality rates in the study period. Non-parametric trend test was used in analyses of changes in body region and the type of lesion in the study period.[16] The study was approved by the National Data Protection Agency.

3. Results

In the study period 1991–2002, 14,316 victims of deliberate physical interpersonal violence from the Odense Municipality were treated at Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark. At the A and E department 14,282 patients were registered and 20 patients were registered at the Institute of Forensic Medicine. Another, 14 patients were registered at both places. Overall 10,481 (73%) were males corresponding to a male/female ratio of 2.7. The median age was 25 years (range 0–94 years) for males and 31 years (range 0–99 years) for females (Mann–Whitney, $p = 0.000$).

The overall incidence rate was 6.5 (95% CI: 6.4–6.6) per 1000 population/year and the rate decreased significantly in the study period (Poisson regression, $p = 0.01$). The development in gender specific annual incidence rates is shown in Table 1. For males the overall incidence rate was 9.9 per 1000 population/year (95% CI: 9.7–10.1) and the rate decreased significantly in the study period (Poisson regression, $p = 0.001$). For females the overall incidence rates were 3.4 (95% CI: 3.3–3.5) per 1000 population/year with no change in the study period (Poisson regression, $p = 0.588$).

Table 2 summarizes the development in the gender specific annual incidence rates according to different age groups. For both males and females the highest overall

Table 1
Gender specific annual incidence rates per 1000 population/year for victims of violence treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1991–2002

Year	Males				Females			
	N	Population	Incidence rate	95% CI	N	Population	Incidence rate	95% CI
1991	906	86,753	10.4	[9.8–11.1]	336	92,044	3.6	[3.3–4.1]
1992	922	87,415	10.6	[9.9–11.4]	327	92,776	3.5	[3.2–3.9]
1993	868	87,898	9.9	[9.2–10.6]	288	93,076	3.1	[2.8–3.5]
1994	1058	88,302	12.0	[11.3–12.7]	321	93,550	3.4	[3.1–3.8]
1995	815	88,601	9.2	[8.6–9.9]	307	93,925	3.3	[2.9–3.7]
1996	771	89,121	8.7	[8.1–9.3]	275	94,309	2.9	[2.6–3.3]
1997	863	89,300	9.7	[9.0–10.3]	322	94,679	3.4	[3.0–3.8]
1998	825	89,012	9.3	[8.6–9.9]	316	94,487	3.3	[3.0–3.7]
1999	828	89,169	9.3	[8.6–9.9]	368	94,400	3.9	[3.5–4.3]
2000	880	89,194	9.9	[9.2–10.5]	328	94,373	3.5	[3.1–3.9]
2001	869	89,194	9.7	[9.1–10.4]	331	94,078	3.5	[3.2–3.9]
2002	876	89,543	9.8	[9.2–10.5]	316	94,221	3.4	[3.0–3.8]
All	10,481	1,063,502	9.9	[9.7–10.1]	3835	1,125,918	3.4	[3.3–3.5]

Table 2
Gender stratified annual incidence rates per 1000 population/year in different age groups for victims treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1991–2002

Age group	Males					Females				
	N	Population	Incidence	95% CI	p-Value[a]	N	Population	Incidence	95% CI	p-Value[a]
0–14	694	186,020	3.7	[3.5–4.0]	0.056	331	179,003	1.9	[1.7–2.1]	0.513
15–24	4431	160,188	27.7	[26.9–28.5]	0.403	990	164,080	6.0	[5.7–6.4]	0.004↑
25–39	3607	273,113	13.2	[12.8–13.6]	0.386	1304	259,430	5.0	[4.8–5.3]	0.030↓
40–59	1565	271,060	5.8	[5.5–6.1]	0.389	914	277,107	3.3	[3.1–3.5]	0.092
60	184	273,121	1.1	[0.9–1.2]	0.169	296	246,298	1.2	[1.1–1.3]	0.778
All	10,481	1,063,502	9.9	[9.7–10.1]	0.001↓	3835	1,125,918	3.4	[3.3–3.5]	0.588

[a] p-values refer to Poisson regression for change in the annual incidence in the study period.

incidence rates were in the age group 15–24 years, respectively, 27.7 (95% CI: 26.9–28.5) and 6.0 (95% CI: 5.7–6.4) per 1000 population/year. There was no significant change in the incidence rates in any of the age groups for males. For females the annual incidence rate increased significantly in the age group 15–24 years (Poisson regression, $p = 0.004$) and decreased significantly in the age group 25–39 years (Poisson regression, $p = 0.030$). Fig. 1 shows the development in the annual incidence rate in the age group 15–24 years for males and females. As the age group with the highest incidence rates the age groups account 38% of the total number of cases.

In the period 1994–2002, 10,669 victims with 16,733 lesions corresponding to 1.6 lesions per victim in both
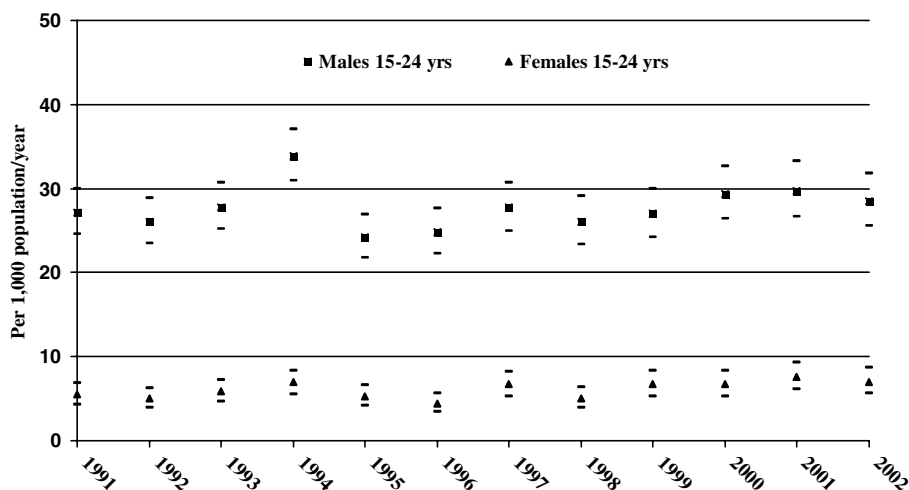

Fig. 1. Development in the annual incidence rate per 1000 population/year and 95% CI in the age group 15–24 years for males and females treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1991–2002.

males and females were registered. Table 3 shows the percentage distribution and development in body region injured according to gender 1994–2002. For both males and females the majority of the injuries were in the head or neck (63% and 49%) and the upper limbs (18% and 24%). In the study period, the percentage of injuries in the head or neck decreased significantly in the group of

males (non-parametric trend test, $p = 0.01$) and increased significantly in the group of females (non-parametric trend test, $p = 0.03$). No significant trends were found in any other body region for both males and females.

Table 4 shows the percentage distribution and development in relation to type of injuries 1994–2002. For both males and females less serious injuries (abrasion or contusion) and

Table 3
The percentage distribution and development in body region for 16,733 lesions in 10,669 victims of violence treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1994–2002

	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total	p-Value[a]
Males											
Head or neck	64	67	64	62	62	63	62	61	61	63	0.01↓
Thorax or abdomen	6	7	6	9	9	9	9	7	8	8	0.20
Upper limbs	19	16	18	18	19	17	19	19	19	18	0.22
Lower limbs	5	4	6	6	5	5	5	5	5	5	0.93
Other[a]	6	6	6	5	5	6	5	8	7	6	0.39
Sum	100	100	100	100	100	100	100	100	100	100	
Number	1493	1186	1108	1323	1268	1338	1419	1398	1484	12,017	
Females											
Head or neck	45	47	49	48	45	49	52	50	51	49	0.03↑
Thorax or abdomen	12	10	13	9	10	9	9	10	11	10	0.38
Upper limbs	27	27	22	25	26	25	23	27	22	24	0.27
Lower limbs	7	10	8	11	9	10	9	10	7	9	0.96
Other[a]	9	6	8	7	10	7	7	13	9	8	0.34
Sum	100	100	100	100	100	100	100	100	100	100	
Number	470	455	403	470	508	661	596	628	525	4716	

p-Values refer to non-parametric trend test for change in the percentage of each body region injured in the study period.[16]
[a] Includes poisoning, spine lesions and unspecified lesions.

Table 4
The development in relation to percentage of type of lesion for 16,733 lesions 10,669 in victims of violence treated at the Odense University Hospital or subjected to medicolegal autopsy at the Institute of Forensic Medicine, University of Southern Denmark 1994–2002

	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total	p-Value[c]
Males											
Less serious lesions	40	38	42	49	50	52	53	52	55	48	0.01↑
Wounds	31	31	31	28	26	24	27	25	24	27	0.01↓
Sprains/dislocations	4	3	5	5	4	4	4	4	4	4	0.93
Bone fractures	18	18	14	10	12	11	9	9	9	12	
Deep lesions[a]	3	4	3	3	3	3	2	2	2	3	0.01↓
Other[b]	4	6	5	5	5	6	5	8	6	6	0.02↓
											0.09
Sum	100	100	100	100	100	100	100	100	100	100	
Number	1493	1186	1108	1323	1268	1338	1419	1398	1484	12,017	
Females											
Less serious lesions	55	60	63	62	61	63	65	68	71	64	0.01↑
Wounds	14	15	14	12	15	14	13	12	10	13	0.06
Sprains/dislocations	7	7	4	8	6	3	6	5	4	6	0.12
Bone fractures	13	10	10	10	9	11	9	5	5	9	0.02↓
Deep lesions[a]	4	3	3	2	3	3	2	1	2	2	0.03↓
Other[b]	7	5	6	6	6	6	5	9	8	6	0.31
Sum	100	100	100	100	100	100	100	100	100	100	
Number	470	455	403	470	508	661	596	628	525	4716	

[a] Includes lesions in nerves, tendons, blood vessels, and internal organs.
[b] Includes burns, poisoning, foreign bodies, and unspecified lesions.
[c] p-Values refer to non-parametric trend test for change in the percentage of type of each lesion in the study period.[16]

wounds (penetrating all layer of the skin) were the most common type of injuries (48% and 64% vs. 27% and 13%). Respectively, 3% and 2% of the injuries in males and females were deep injuries (injury in internal organs, nerves, tendons, or blood vessels). For both males and females the percentage of less serious injuries increased in the study period (non-parametric test for trend, $p = 0.01$). In the group of males, the percentage of wounds decreased (non-parametric trend test, $p = 0.01$). The percentage of bone fractures and deep injuries decreased for both males (non-parametric trend test, $p = 0.01$ and $p = 0.02$) and females (non-parametric trend test, $p = 0.02$ and $p = 0.03$) in the study period 1994–2002.

Ninety-one percent of the males and 95% of the females were victims of blunt violence (fist, club etc.), whereas in 8% of the men and 4% of the females a sharp instrument had been used. In 1% of both males and females the violation method was unspecified. Three percent of the patients were stabbed with a knife and 0.4% had injuries due to fire-arms. The percentages did not change in the study period 1991–2002 (non-parametric trend test, $p = 0.91$, $p = 0.94$). Eight percent were hospitalised with at median of 3 (1–184) days the hospital. The percentage showed no change in the study period (trend test, $p = 0.25$).

Thirty-four (2.5 per 1000 victims) patients died following their injuries corresponding to mortality rate of 1.6 per 100,000 population/year. There was no change in the mortality rate in the study period (Poisson regression, $p = 0.168$). Of those who died 29% were stabbed or cut with a knife and 12% had injuries due to firearms. Those who died had 137 injuries corresponding to 4.0 injuries per victim. Fifty-six percent of the injuries were in the head/neck, 27% in the thorax/abdomen, and 17% were in the limbs or other body regions. Seven percent of the injuries were less serious (abrasion or contusion), 21% were wounds, 18% were bone fractures, 41% were deep injuries, and 13% were other types of injuries.

4. Discussion

The present study does not support an increasing frequency of deliberate interpersonal violence. Based on A and E department and forensic data we found both a slightly and significantly decreasing overall and gender specific annual incidence rate for males in a local region involving about 5% of the entire Danish population. Furthermore, we did not find any evidence that violence has become more brutal. This is in contrast to the general public opinion.

The annual incidence rates varied with age and gender. Males had a 3-fold higher overall annual incidence rate than females (9.9 vs. 3.4 per 1000 population/year). The highest annual incidence rates were in the younger population (15–24 years) for both males and females. In the study period, the annual incidence rates did not show any significant change according to different age groups for males.

For females the annual incidence rate increased in the age group 15–24 years and decreased in the age group 24–39 years.

In a former study from the Odense Municipality the annual overall incidence rate declined from 8.4 to 5.7 per 1000 population/year in the period 1988–1996.[17] The present study shows that this trend has stabilized. In another Danish study from the city of Aarhus the overall annual incidence rate decreased from 6.5 to 4.6 per 1000 population/year in the period from 1981 to 2000.[5]

Data from the Norwegian Injury Sample Registry showed an average annual incidence rate of violence of 3.8 per 1000 population/year in the period 1990–1999.[11] In the same period the annual incidence rate decreased 15–20%. A prospective study from 58 A and E departments in England and Wales from 1995 to 2000 showed no significant changes in the incidence rates of violence throughout the period, except among males aged 11–17 years who experienced an increased incidence rate.[10]

The annual incidence rates, as described in our study, include only those cases requiring medical attention at the hospital or medicolegal autopsy at the Institute of Forensic Medicine. Possible selection bias arises as we have no information available about the total number of cases who seek medical attention at general practitioners or in neighbouring hospitals A previous study from the Odense Municipality has shown that about 11% of injuries, mostly of minor nature such as contusions, sprains, and simple fractures, are treated by the general practitioners.[18] Analysis of the study region (approx. radius of 45 km) has shown that only 2% of all victims of interpersonal violence from Odense municipality seek medical attention in the nearest neighbouring hospitals 45 km away.[19] Furthermore, no changes in the referral principles or organisation of treatment of injury patients in the study region have been made in the study period. Therefore, a possible selection bias affecting the development in frequency and severity is less likely.

Unfortunately, we have no information about interpersonal violence which is not registered in the health care or forensic system. Especially, our sampling methods may underestimate the incidence rates where the victim is in a dependent relationship with the perpetrator. In a Danish survey, 6% of the males and 4% of the females have been exposed to violence within the past year.[2] These percentages are in contrast to the actual number of contacts to the hospitals. However, the majority of these cases may be less severe. In an English survey 20% of the females and 8% of the males reported physical or sexual assault, or both, in the past year.[20]

We have only limited information of those victims who are recorded by the Police solely. We know from a still unpublished study that 13% of all registered victims in Odense Municipality in 2003 were solely registered by the police. In a former Danish study 15% of all registered victims of violence were solely registered in the police records

without seeking medical attention in the hospital.[21] The majority of these cases may also be less severe. However, the aspect should have more focus in further analyses. The last decades the number of police reported violence has increased steadily in Denmark due to a rise in the tendency of reporting the violence among the victims.[3]

The majority of the injuries in our study were in the head or neck and upper limbs, whereas injuries in the thorax or the abdomen accounted for less than 1/10 of the injuries. For both males and females 3/4 of the injuries were less serious injuries or wounds, whereas deeper and potentially dangerous injuries accounted for only 2–3%. Other papers have shown the same distribution of lesions according body to region and type of injuries.[11,13,22–25] We did not find any rise in the percentage of more severe injuries in the study period. On the contrary, the percentage of less serious injuries increased from 1994 to 2002 for both males and females, whereas the percentage of bone fractures and deep injuries decreased slightly. Another Danish study showed an unchanged pattern with regard to the degree of violence.[13]

The use of injuries as a tool for measuring changes in severity of violence is not optimal. However, no reliable and validated tool for severity rating of injuries due to violence exists. The abbreviated injury scale (AIS) has been used in several studies.[5,13,23,26–29] The AIS classification reflects probability of death. In these studies, 80–90% of the injuries from violence are rated as minor (AIS = 1).[13,23,26–30] Unfortunately, the AIS cannot distinguish changes within the large group of patients with minor injuries. AIS has, therefore, low sensitivity for measuring change over time.

The overall mortality rate of 1.6 per 100,000 population/year in our study is low. The overall global mortality rate of deliberate violence is 10.7 per 100,000 population/year.[30] On a national level, about 60 individuals die each year in Denmark due to deliberate interpersonal violence.[31] In Denmark, deaths from deliberate interpersonal violence less common than both deaths from suicide and accidents.[31] The mortality rate in our study is similar to mortality rates of deliberate violence in other established market economies excluding the US.[30]

Penetrating injuries due to stab/cut wounds and gunshot wounds are relatively uncommon in Scandinavia.[14,32,33] In our study 3.4% of all incidents involved lesions due to stabs or cuts with knife or gunshot in contrast to roughly half among those who died. The percentage of weapon use was unchanged in the study period. Brink showed the same unchanged pattern in another Danish urban population in the study periods 1981–82, 1987–88, and 1993–94.[13]

In a Danish survey, 42% of females and 9% of males avoid empty or desolate parts of cities because of the risk of exposure to violence or sexual assault.[2] This is in contrast to our results which indicate that males are three times more likely to become victims of violence than females. On one hand, a certain media focus upon violence may lead to this avoiding behaviour. On the other hand, the media focus upon violence and the avoiding behaviour may have lead to a reduction in the frequency of violence.

5. Conclusions

Based on A and E department and forensic data we found no evidence of an increase in the incidence of deliberate interpersonal violence in the time period 1991–2002. Furthermore, the study did find that injuries from violence have become more severe. The findings from this study are consistent with other Danish studies of violence based on A and E department and/or forensic data.

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